POW WOW 2007 - Fun with Rockets!

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Objective: Learn how to make safe, simple non-fuel type rockets (paper, pencil, water rockets) to incorporate in your den or pack program.

Wesley's Website: http://wwong.homestead.com/rockets.html

On-line Resources:

- http://ourworld.compuserve.com/homepages/pagrosse/h2oRocketIndex.htm
- http://www.grc.nasa.gov/WWW/K-12/airplane/bgmr.html
- http://edtech.kennesaw.edu/web/solar.html
- http://www.water-rockets.com/javasim/index.html
- http://mpassero.tripod.com/rocket/index.htm

Rocket Pop! Launch Pad:

- http://www.everyoneslaser.com/rocketpop/rocketpop_sales.htm

Class Outline

I. Introduction (5')
- Distribute Handouts
- Sign-in Sheet
- Brief history of Rockets

II. Rocket Principles (2')
- Newton's 3 Laws of Motion
- Rocket Pinwheel

III. Incorporating into Den or Pack Program (3')
- Wolf, Bear, Webelos Achievements
- Space Theme
- Rocket Derby

IV. Rocket Safety (2')

V. Types of Rockets & Construction Tips (18')
- A. Paper & Pencil Rockets
- B. Balloon Rocket
- C. Air & Foam Rockets
- D. Seltzer Rockets
  - Basic Film Canister
  - Canister with Fins & Nosecone
  - Double canister
- E. Water Rockets
  - Basic Water bottle
  - Water bottle with fins & nosecone
  - Paper tube rockets
  - All plastic rockets
  - Launch Pads

VI. Rocket Construction (15')
- Form into groups of 3-5 people.
- Build rocket from Kit

VII. Rocket Launch. (5-10')

Den & Pack Activities with Rockets

Den Activities:

Wolf Elective 5g:	Make a model rocket.
Bear Achievement 21f:	Make a model of a rocket.
Elective 1d:	Build a model of a rocket or space satellite.
Webelos Scientist 5:	Show the effects of air pressure.
6:	Show the effects of water & air pressure.
7:	Build and launch a model rocket.

Pack Activities:

- Space Theme
- Space Derby or Rocket Derby
- Pack picnic or barbecue
- Scout-O-Ramas
- Camporees

Rocket Activities:

- Can be used in the den, the Pack or classroom.
- Can be incorporated in the Webelos Scientist badge.
- Can illustrate the effects of air pressure and water pressure
- Can be used to teach the scientific method. Experiment with different amounts of water and chart the launch times vs. water level. Experiment with different fin designs and see which ones give the best flight.
- Foster creativity and exploration. Give materials to the boys without any directions, and have them put together a rocket they think will fly the highest. Explore options for recovery systems such as parachutes.

Rocket Safety Tips

Construction Safety Precautions:

- Always use glue in a well-ventilated area.
- Cover the work area with paper or a cloth in case glue drips.

Pressure Testing Water Rockets:

- Never use glass bottles for water rockets.
- Always fill rocket completely with water when pressure testing. This will reduce the explosive hazard of the compressed air.
- Pressurize slowly, and if possible open the air pressure valve so that the air bubbles slowly into the rocket. Then back away and wait for the pressure to stabilize in the rocket with no more bubble action.

Launch Safety Precautions:

- Never launch a rocket over 400ft without FAA clearance.
- Never launch in a crowded area.
- Choose an open field that is clear of obstructions such as trees and wires.

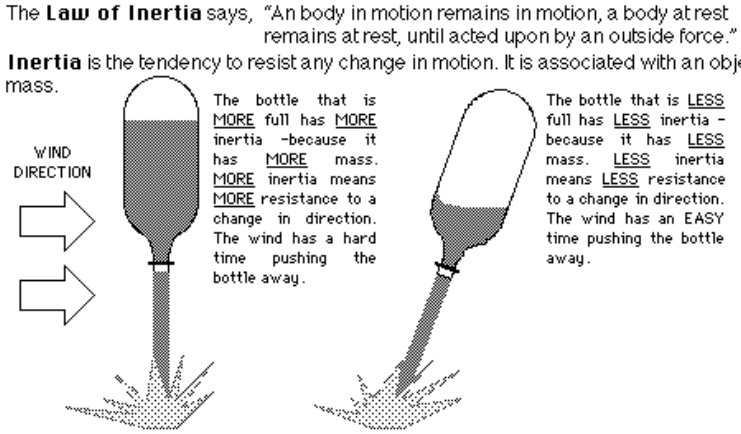
- Never stand directly over the launch pad while setting rocket on pad or during launch.
- Have each student or student group set up their own rocket on the launch pad. Other students should stand back several meters. It will be easier to keep observers away by roping off the launch site.
- Only permit the students launching the rocket to retrieve it.
- The student pressurizing the rocket should put on eye protection (safety goggles).

- Launch under low pressure first.
- Launch under zero or gentle breeze conditions.
- Place the launcher in the center of the field and anchor it in place with the spikes or tent stakes.
- When pressurization is complete, all students should stand in back of the rope for the countdown. Launch the rocket when the recovery range is clear.

Rocket Principles

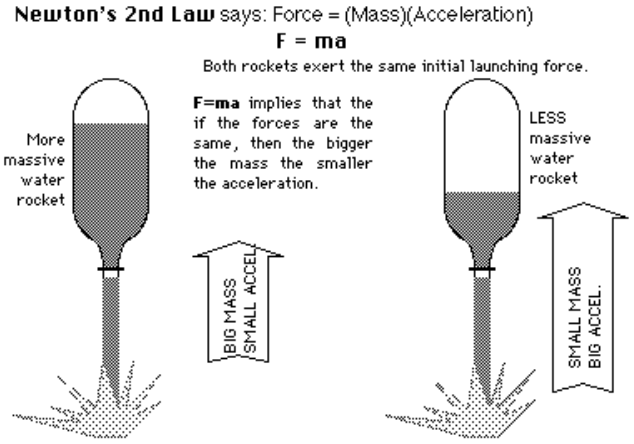
Newton's First Law

This law of motion is just an obvious statement of fact.

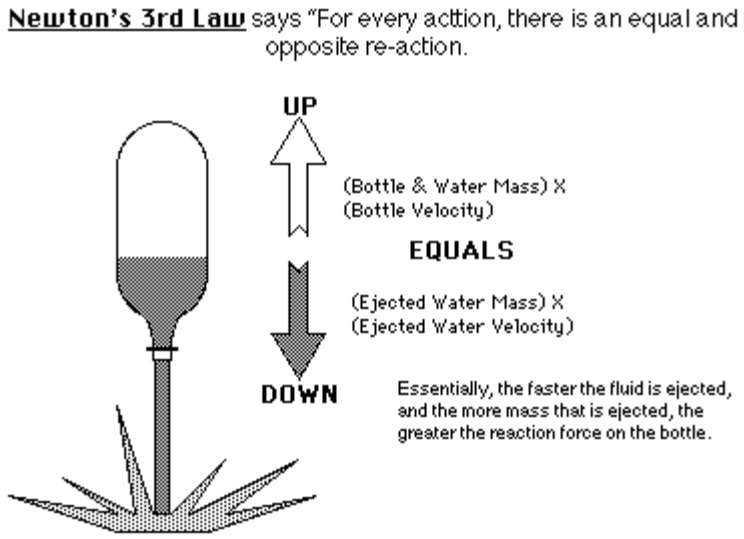


Newton's Second Law

This law of motion is essentially a statement of a mathematical equation. The three parts of the equation are mass (m), acceleration (a), and force (f).

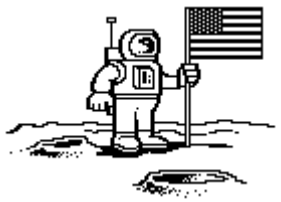


Newton's Third Law



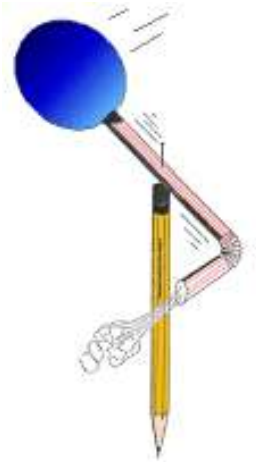
Putting Newton's Laws of Motion Together

An unbalanced force must be exerted for a rocket to lift off from a launch pad or for a craft in space to change speed or direction (First Law). The amount of thrust (force) produced by a rocket engine will be determined by the rate at which the mass of the rocket fuel burns and the speed of the gas escaping the rocket (Second Law). The reaction, or motion, of the rocket is equal to and in the opposite direction of the action, or thrust, from the engine (Third Law).



Rocket Pinwheel

TOPIC: Action-Reaction Principle
DESCRIPTION: Construct a balloon- powered pinwheel.



MATERIALS:

- Wooden pencil with an eraser on one end
- Sewing pin
- Round party balloon
- Flexible soda straw
- Plastic tape

METHOD:

1. Inflate the balloon to stretch it out a bit.

2. Slip the nozzle end of the balloon over the end of the straw farthest away from the bend. Use a short piece of plastic tape to seal the balloon to the straw. The balloon should inflate when you blow through the straw.

3. Bend the opposite end of the straw at a right angle.

4. Lay the straw and balloon on an outstretched finger so that it balances and mark the balance point. Push the pin through the straw at the balance point and then continue pushing the pin into the eraser of the pencil and finally into the wood itself.

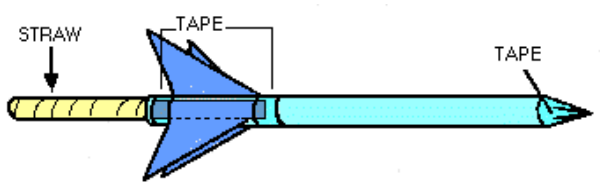
5. Spin the straw a few times to loosen up the hole the pin has made.

6. Blow in the straw to inflate the balloon and then let go of the straw.

DISCUSSION: The balloon-powered pinwheel spins because of the action-reaction principle described in Newton's Third Law of Motion. Stated simply, the law says every action is, accompanied by an opposite and equal reaction. In this case, the balloon produces an action by squeezing on the air inside causing it to rush out the straw. The air, traveling around the bend in the straw, imparts a reaction force at a right angle to the straw. The result is that the balloon and straw spins around the pin.

Paper Rocket

TOPIC: Stability
DESCRIPTION: Small flying rockets to make out of paper and propel with air blown through a straw.



MATERIALS:

- Scrap bond paper
- Cellophane tape

- Scissors
- Sharpened fat pencil
- Milkshake straw (slightly thinner than pencil)

PROCEDURE:

1. Cut a narrow rectangular strip of paper about 5 inches long and roll it tightly around the fat pencil. Tape the cylinder and remove it from the pencil.

2. Cut crown points into one end of the cylinder and slip it back onto the pencil.

3. Slide the crown points to the pencil tip and squeeze the points together and tape them together to seal the end to form a nose cone (the pencil point provides support for taping). An alternative to the crown points is to just fold over one end of the tube and seal it with tape.

4. Remove the cylinder from the pencil and gently blow into the open end to check for leaks. If air easily escapes, use more tape to seal the leaks.

5. Cut out two sets of fins using the pattern and fold according to instructions. Tape the fins near the open end of the cylinder. The tabs make taping easy.

FLYING THE PAPER ROCKET:

Slip the straw into the rocket's opening. Point the rocket towards a safe direction, sharply blow through the straw. The rocket will shoot away. Be careful not to aim the rocket towards anyone because the rocket could poke an eye.

DISCUSSION: Paper rockets demonstrate how rockets fly through the atmosphere and the importance of having fins for control. For experimental purposes, try building a rocket with no fins and one with the fins in the front to see how they will fly. Practice flying the rockets on a ballistic trajectory towards a target. Also try making a rocket with wings so that it will glide.

Pencil Rocket

TOPIC: Rockets
DESCRIPTION: Rockets, using pencils for their bodies, are launched with a rubber band-powered launch platform.

MATERIALS and TOOLS:

- 2 Pieces of wood 3'X4"Xl" in size
- 2 Cup hooks
- 1 Wooden spring clothes pin
- 1 Small wood screw
- 1 Screw eye
- 2 Metal angle irons and screws
- 4 Feet of heavy string
- Iron bailing wire (18 gauge minimum)
- Several rubber bands
- Several wooden pencils (unsharpened)
- Several pencil cap erasers
- Cellophane or masking tap
- Heavy paper
- Saw
- Wood file
- Drill (3/16 inch diameter)
- Pliers

PROCEDURE

Launch Platform

1. Join the two pieces of wood as shown in the diagram to form the launch platform. Use a metal angle iron on each side to strengthen the structure.

2. Screw in the cup hooks and screw eye into the wood in the places indicated in figure 1.

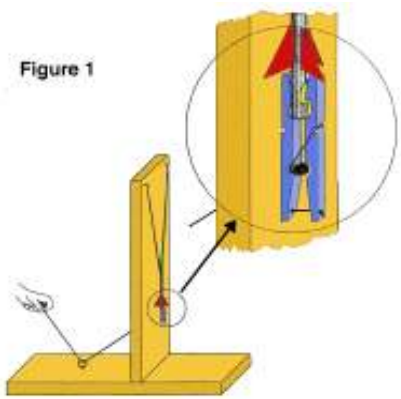


Figure 2

3. Temporarily separate the wooden pieces of the clothes pin and file the "jaw" of one piece square as shown in figure 2. Drill two holes through the other wood piece as shown. Drill one hole through the first wood piece as shown.

4. Drill a hole through the upright piece of the launch platform as shown and screw the clothes pin to it so that the lower hole in the pin lines up with the hole in the upright. Reassemble the clothes pin.

5. Tie a knot in one end of the string and feed it through the clothes pin as shown in figure 1, through the upright piece of the platform and then through the screw eye. When the free end of the string is pulled, the clothes pin will pen. The clothes pin has become a rocket hold-down and release device.

6. Loop four rubber bands together and loop their ends on the cup hooks. The launch platform is now complete.

Rocket

1. Take a short piece of bailing wire and wrap it around the eraser end of the pencil about one inch from the end. Use pliers to twist the wire tightly so that it "bites" into the wood a bit. Next, bend the twisted ends into a hook as shown in figure 3.

2. Take a sharp knife and cut a notch in the other end of the pencil as shown in figure 3.

3. Cut out small paper rocket fins and tape them to the pencil just above the notch.

4. Place an eraser cap over the upper end of the rocket. This blunts the nose to make the rocket safer if it hits something.

The rocket is now complete.

LAUNCHING PENCIL ROCKETS:

1. Choose a wide-open outdoor area to launch the rockets.

2. Spread open the jaw of the clothes pin and place the notched end of the rocket in the jaws. Close the jaws and gently pull the pencil upward to insure the rocket is secure. If the rocket doesn't fit, change the shape of the notch slightly.

3. Pull the rubber bands down and loop them over the wire hook. Be sure not to look down over the rocket as you do this in case the rocket is prematurely released.

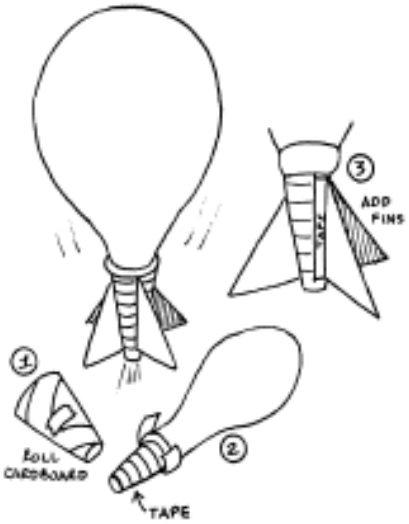
4. Stand at the other end of the launcher and step on the wood to provide additional support.

5. Make sure no one except yourself is standing next to the launch pad. Count down from 10 and pull the string. Step out of the way from the rocket as, it flies about 75 feet up in the air, gracefully turns upside down and returns to Earth.

6. The rocket's terminal altitude can be adjusted by increasing or decreasing the tension on the rubber bands.

DISCUSSION: Like the flight of Robert Goddard's first liquid fuel rocket in 1926, the pencil rocket gets its upward thrust from its nose end rather than its tail. Regardless, the rocket's fins still provide stability, guiding the rocket upward for a smooth flight. If a steady wind is blowing during flight, the fins will steer the rocket towards the wind in a process called 'weather cocking.' On NASA rockets, active controls steer during flight to prevent weather cocking and to aim them on the right trajectory. Active controls include tilting nozzles and various forms of fins and vanes.

Balloon Rocket



1. Roll a 4” x 5” piece of stiff paper into a shape like an ice cream cone. Use tape to hold in place. This is the rocket engine. Cut larger end to fit tightly inside balloon neck.

2. Tape balloon and engine together. Wrap tape around engine to close up air leaks. Blow up balloon. Let it go straight up. Trim off the top of the engine a little at a time until the balloon rises straight and steady.

3. Tape paper fins in place to help the balloon fly steady.

Alka-Seltzer Rockets

Purpose

To design a paper rocket propelled by Alka-Seltzer and water to demonstrate Newton's third law of motion.

Background

The paper rocket in this activity is propelled according to the principle stated in Isaac Newton's third law of motion: "For every action there is an opposite and equal reaction." Gas pressure builds inside the film canister due to the mixing of Alka-Seltzer and water. This action continues until enough pressure builds to blow apart the canister from its lid. The reaction is the launch of the rocket.

Materials

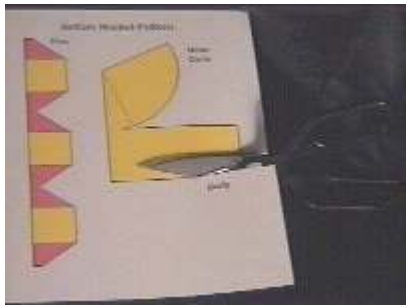
card stock printed pattern; empty film canister with lid that snaps inside; markers, crayons, or colored pencils; tape; glue; scissors; Alka-Seltzer tablets; water; metric tape measure or meter sticks; straw; (Optional launch pad: wood block, coat hanger or other stiff wire)

Preparation

Review and prepare materials. It is most important to use film canisters with lids that snap inside. Do not use lids that close around the outside of the canister.

Construction

1. Cut the fins out. Cut the nose cone and body out as one piece.



2. Tape the body onto the film canister, roll the paper around the side, and tape the end down. The lid end of the film canister goes down.


3. Roll the nose cone around in the shape of a cone and tape it together. Straighten the nose cone point to the center of the rocket and tape it to the sides.


4. Fold the fins so that the colored side is out. Tape or glue the fin halves together to form a complete circle.


5. Fold the fins so that the colored side is out. Tape or glue the fin halves together to form a complete circle.

6. Cut a 1-inch piece of straw and tape it to the body.

Launch Time

This is an outdoor activity. If gusty winds are a problem, then place a quarter in the canister to keep the rocket from falling over. Launching near a wall where a metric tape has been hung or where meter sticks have been stacked may make it easier to judge how high the rocket goes. You may want to wear safety glasses during this experiment as a general safety precaution. Everyone should stand away from loaded rockets when they are on the launch pad. It may take 15 to 20 seconds to build up enough pressure to launch, so a loaded rocket should not be approached prematurely. These rockets can shoot 5 meters or more into the air. No sharp objects should be placed on top of the nose cone or elsewhere on the rocket.

Make a launch pad with a block of wood and a straight piece of wire. Drill a hole for the wire and insert the wire straight up to guide the rocket at lift off.

Wrap-up

One way to record the results of different "fuel" mixtures is to make a simple graph of height vs. amount of water. Such a graph gives a clear, visual record of the observations and can be used as evidence to support interpretations.

Design and launch other rockets powered by two, three or more film canisters.

Design a two-stage rocket.

Soda Bottle Rockets

Materials

2 soda bottles; card stock printed pattern; markers, crayons, or colored pencils; tape; glue; scissors; water; wood block approximately 4" long piece of "2 by 4" lumber; one wood screw; one rubber automotive valve stem; bicycle tire pump.

Preparation

Review and prepare materials. Build the launch pad by cutting 2 1/2" off the cap end of the bottle. Cut a 3/8" slot down one side of the bottle for the tire pump hose. Drill or punch a hole in the bottom of the bottle. Screw the bottle to the block of wood.

Construction

1. Print the patterns. Cut the fins out. Cut the nose cone out.

2. Roll and tape the nose cone. Tape the nose cone to the bottom of the whole soda bottle.

3. Fold the fins at all the dotted lines. Glue or tape two of the fins together. Wrap the fins around the middle of the whole soda bottle and glue or tape the last fin together.

Launch Time

This is an outdoor activity. If gusty winds are a problem, then abort the launch. Everyone should stand away from rockets when they are on the launch pad. These rockets can shoot 100 feet or more into the air. No sharp objects should be placed on top of the nose cone or elsewhere on the rocket.
Fill the soda bottle a little less than half way with water. Shove the large end of the tire valve stem into the neck of the bottle. Attach the bicycle pump hose to the valve stem. Lower the bottle into the launch pad so that the hose slides down into the slot, the valve stem points down and the bottle rests on top of the cut bottle.

Pump up the bottle until it pops off the valve stem and flies to new heights.

Wrap-up

One way to record the results of different "fuel" mixtures is to make a simple graph of height vs. amount of water. Such a graph gives a clear, visual record of the observations and can be used as evidence to support interpretations.
Design and launch other rockets. Design a two-stage rocket. Design recovery mechanisms such as parachute, ribbon or propeller.

Water Rockets - The Parts

Water rockets consist of the following parts:

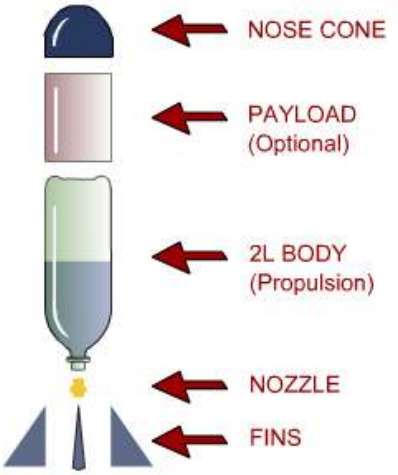
Nose Cone - an extension of the bottle that comes in a variety of shapes and is used to improve the aerodynamics of the rocket.

Payload section - an optional section that could hold a parachute or a payload.

Body - a 2 liter soda or pop bottle that serves as the propusion compartment or "engine" of the water rocket.

Nozzle - a part that fits into the bottle opening to help in the propulsion of the rocket and provides a mounting point for launchers.

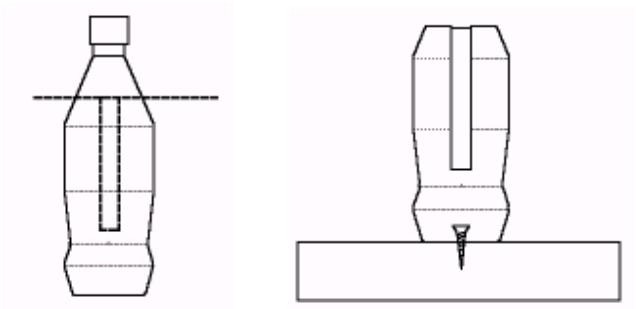
Fins - a part that helps to stabilize the water rocket.



Soda Bottle Launch Pad

You can use a bicycle pump, soda bottle, one screw, a piece of 2x4 scrap and an automotive tire valve stem to create a launch pad.

1. Take an empty soda bottle and cut it as shown below (left), cut the top off and cut a slot wide enough for the bicycle pump hose and deep enough to slide in the rocket, valve stem and bicycle pump hose fitting (the rocket should rest on the cut end of the soda bottle launch pad:



2. Screw the soda bottle to a scrap piece of 2x4 as shown above (right).

3. Shove the tire valve stem into the neck of your soda bottle rocket (Fig. 3).

4. Attach the bicycle pump to the valve stem.

5. Slide the soda bottle rocket with hose attached into the launch pad. See the finished pad ready to launch (Fig. 4).

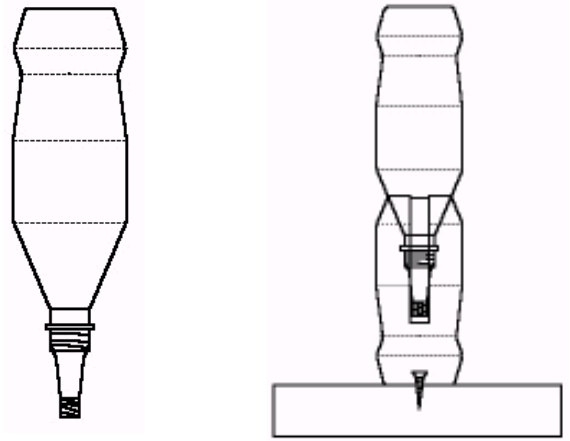


Fig. 3 Fig. 4

6. Pump it up until it pops!

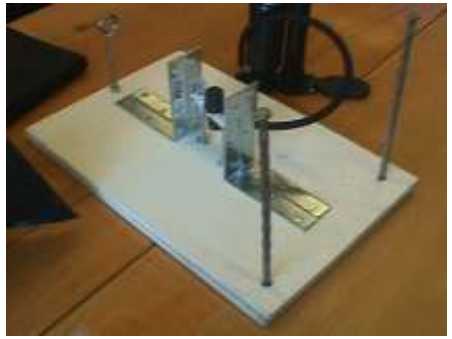
Launch Pad 2 (Advanced)

(From the NASA Website)

Most needed parts for this pad are available from hardware stores. In addition, you will need a tire valve from an auto parts store and a rubber bottle stopper from a school science experiment. The most difficult task is to drill a 3/8-inch hole in the mending plate. An electric drill is a common household tool. If you do not have access to a drill or do not wish to drill the holes in the metal mending plate, find someone who can do the job for you. Ask a teacher or student in your school's industrial arts shop or the parent of a student to help.

Materials:

· 4 5-inch corner irons with 12 3/4-inch wood screws to fit
· 1 5-inch mounting plate
· 2 6-inch spikes
· 2 10-inch spikes or metal tent stakes
· 2 5-inch by 1/4-inch carriage bolts with 6 1/4-inch nuts
· 1 3-inch eyebolt with 2 nuts and washers
· 4 3/4-inch diameter washers to fit bolts
· 1 #3 rubber stopper with a single hole
· 1 Snap-in Tubeless Tire valve (small 0.453 inch hole, 2 inches long)
· Wood board 12 x 18 x 3/4 inches
· 1 2-liter plastic bottle
· Electric drill and bits including a 3/8-inch bit
· Screw driver
· Pliers or open-end wrench to fit nuts
· Vice
· 12 feet of 1/4-inch cord
· Pencil



Construction of the Launcher

1. Prepare the rubber stopper by enlarging the hole with a drill. Grip the stopper lightly with a vice and gently enlarge the hole with a 3/8 inch bit and electric drill. The rubber will stretch during cutting, making the finished hole somewhat less than 3/8 inches.

2. Remove the stopper from the vice and push the needle valve end of the tire stem through the stopper from the narrow end to the wide end.

3. Prepare the mounting plate by drilling a 1-3/8 inch hole through the center of the plate. **(*As safety precautions, hold the plate with a vice during drilling and wear eye protection.*)** Using a drill bit slightly larger than the holes, enlarge the holes at the opposite ends of the plates. The holes must be large enough to pass the carriage bolts through them.

4. Lay the mending plate in the center of the wood base and mark the centers of the two outside holes that you enlarged. Drill holes through the wood big enough to pass the carriage bolts through.

5. Push and twist the tire stem into the hole you drilled in the center of the mounting plate. The fat end of the stopper should rest on the plate.

6. Insert the carriage bolts through the wood base from the bottom up. Place a hex nut over each bolt and tighten the nut so that the bolt head pulls into the wood.

7. Screw a second nut over each bolt and spin it about halfway down the bolt. Place a washer over each nut and slip the mounting plate over the two bolts.

8. Press the neck of a 2-liter plastic bottle over the stopper. You will be using the bottle's wide-neck lip for measuring in the next step.

9. Set up two corner irons so that they look like bookends. Insert a spike through the top hole of each iron. Slide the irons near the bottleneck so that the spike rests immediately above the wide neck lip. The spike will hold the bottle in place while you pump up the rocket. If the bottle is too low, adjust the nuts beneath the mounting plate on both sides to raise it.

10. Set up the other two corner irons as you did in the previous step. Place them on the opposite side of the bottle. When you have the irons aligned so that the spikes rest above and hold the bottle lip, mark the centers of the holes on the wood base. (*For more precise screwing, drill small pilot holes for each screw and then screw the corner irons tightly to the base.*)

11. Install an eyebolt to the edge of the opposite holes for the hold-down spikes. Drill a hole and hold the bolt in place with washers and nuts on top and bottom.

12. Attach the launch "pull cord" to the head end of each spike. Run the cord through the eyebolt.

13. Make final adjustments to the launcher by attaching the pump to the tire stem and pumping up the bottle. Refer to the launching instructions for safety notes. If the air seeps out around the stopper, the stopper is too loose. Use a pair of pliers or a wrench to raise each side of the mounting plate in turn to press the stopper with slightly more force to the bottleneck. When satisfied with the position, thread the remaining hex nuts over the mounting plate and tighten them to hold the plate in position.

14. Drill two holes through the wood base along one side. The holes should be large enough to accommodate large spikes (metal tent stakes). When the launch pad is set up on a grassy field, the stakes will hold the launcher in place as you yank the pull cord to launch the rocket.

Paper Wrapped Rockets

These rockets are made by wrapping heavy paper around two 20-ounce soda bottles. The red one is 19" long. Two 20-ounce bottles are placed end-to-end and taped together. Then a 12"x10" sheet of colored poster board is wrapped around and taped to the bottles. The 3" fin pattern from the handout is used for this rocket.

The white one is 28" long. A 26"x20" sheet of heavy-stock paper (at least 40-lb stock) is wrapped around the two 20-ounce bottles that are taped to one of the 20" sides of the sheet, so that about 2-1/2" of each bottle extends beyond each

edge of the sheet. The 4-1/2" fin pattern from the handout is used for this rocket. The longer rocket (white one), may require two people to assemble (a Cub Scout and his buddy or adult partner). Since it is longer than the red rocket, it will be more stable and fly straighter than the red one. The red rocket will flip in flight, but is simpler to make.and looks just as cool.

All Plastic Rocket (Barbie Rocket)

This rocket is made by taping two 20-ounce bottles to the ends of a plastic mailing tube. The fins are cut from a sheet of heavy plastic mylar. I was able to find some recycled plastic sheets that I cut out and doubled over for the fins. The top bottle is the nosecone.and is sealed with a bottle cap. You can place an object (payload) in the top bottle, or in the mailing tube before it is taped to the bottles. You will notce that this rocket has a passenger (a small Barbie doll from a McDonalds happy meal).

This rocket appeals to the girls and the Moms, as well as the boys. The boys think that Barbie will blow up. Barbie has survived over 50 flights! Because the rocket is all plastic, it is very light, and flies very high. It also lands harder than the all paper rockets, so you will need a larger and softer landing area. When the nosecone becomes too mangled, it is replaced with a new bottle.

Water Rocket Derby

What is a Rocket Derby?

A rocket derby is a great summertime Pack activity that a scout can do with the whole family. It requires less preparation and setup than the propeller driven space derby kits. A rocket derby uses water rockets that are propelled with water and air pressure. The rockets are simple enough to assemble that Tiger Cubs and siblings age 4 and older can also participate. The scouts and parents get a great thrill at seeing their rockets fly skyward. The rockets can fly up to 100-150 feet in the air.

Solid fuel type rockets such as Estes rockets are beyond the capabilities of most Cub Scouts and are not recommended for a Cub Scout rocket derby.

Rocket Derby Kit

The basic rocket consists of an 18" mailing tube, a 20 oz. soda bottle, fins and a nosecone. Gather the materials well in advance.

Materials List:

18" cardboard mailing tube with tube cap	Small quantities of mailing tubes can be purchased from the post office of mailing supply stores (Mailboxes Etc.). Bulk quantities can be ordered from the internet at reduced prices. Papermart.com has some of the best prices. Cut the tube into a 12” section and 6” section.
20 oz. plastic soda bottle (empty)	Ask your local eating establishment or office building with a soda bottle vending machine if you can collect their empty soda bottles.
Poster board	Get these in a variety of bright colors for the nosecone.
Matte board	This is the thick cardboard used for framing pictures and photos. Some framing stores sell their scrap pieces for very low prices.
Fun Foam	This can be purchased at craft supply stores.

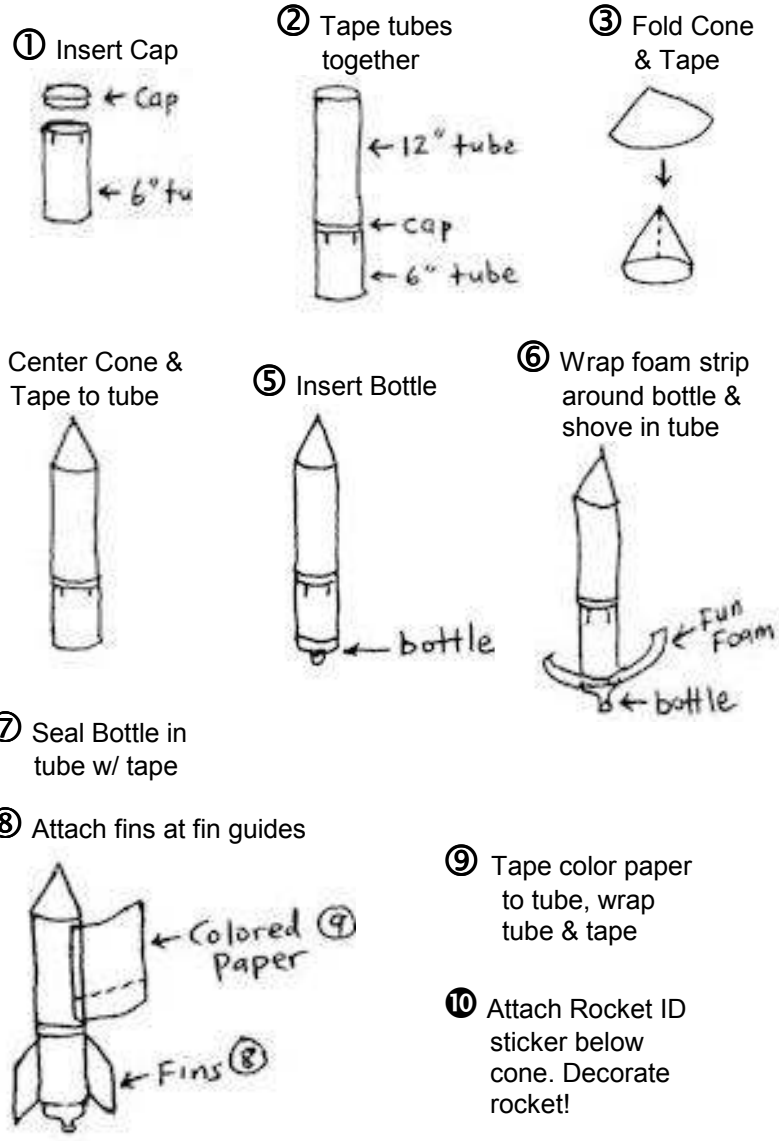
In addition to the above materials, you will also need lots of scissors and rolls of 2" wide clear packing tape. Color paper, stickers and markers can also be provided for decorating the rocket.

Derby Equipment & Supplies

- Safety Cones
- Wind Sock or Flag
- Bicycle Pump or Air Tank
- Water Buckets & Dish Pan
- Empty soda bottles

- **Launch Pad**: This will be the most expensive item required for the rocket derby. You will need a launch pad that is capable of handling up to 100 pounds of air pressure. You can construct your own launcher, or purchase one ready-made. There are several web sites on the internet that have construction plans, and launch pads for purchase. Most launch pads are constructed of PVC piping.

Rocket Construction



These rockets are great for water rocket derbies. They are inexpensive to make, easy to construct and are quite durable. They are capable of reaching over 100 feet in height.

1. Insert the tube cap onto the end of the 6" tube, which has 3 marks for the fin guides.
2. Stack 12" tube onto capped end of short tube. Tape the tubes together.
3. Shape the fan-shaped cardboard into a nosecone and tape together, making sure that the opening fits onto the cardboard tube.
4. Center the nosecone onto the end of the 12" tube, and tape the nosecone onto the tube. Completely cover the nosecone with tape.
5. Insert the plastic soda bottle into the 6" tube, with the opening sticking out.
6. Wrap the strip of fun foam around the top of the bottle, and shove it into the cardboard tube. The fun foam keeps the bottle from moving around in the tube.
7. Seal the bottle in tube with tape.
8. Place each fin onto a fin guide on the 6" tube. The fin point should be pointing toward the nosecone. Tape fins SECURELY onto tube, and cover completely with tape.
9. Wrap the rocket body with 1-1/2 sheets of color paper (will be provided), and tape onto the rocket. Tape the color paper to the tube before wrapping around tube.
10. Attach Rocket ID Sticker below nosecone. Decorate rocket with markers, stickers, etc.

Tips for Running a Rocket Derby

- Plan event well in advance, set date and location (Park with large field).
- Prepare rocket kits in advance. Conduct workshop before event for assembling rockets, or build during a den or pack meeting.
- For competition, judge rockets for flight time (from lift-off to landing).
- Get volunteers (parents) for:
  - Event Coordinator
  - Time keeper (with stopwatch)
  - Water fillers (to fill rockets)
  - Launch crew (to operate the launch pads)
- Compress rockets to a maximum of 85 psi for competition (vary pressure based on wind and enviroment).
- Always follow safety precautions!

Rocket Derby Staff

To run a smooth rocket derby, you must have enough adults to staff the event. Ask some of the parents to help, especially those who are not already Pack leaders. Here are some of the staff positions:

Registration (1)	This person will check in the scout, assign him a number, and inspect the rocket.
Time Keeper (1)	This person will record the time aloft for each rocket with a stopwatch.
Water Filler (1)	This person will assist each boy in filling the rockets with water (1/3 of the bottle is filled with water). Have on hand a bucket of water and extra 20 oz. bottles at the water station.
Launch Crew (2)	Two people are required at the launch pad. One person to place the rocket on the pad, and the other person to pump the air. An air compressor is ideal but requires an electrical outlet. An air tank can be used, but may lose pressure with continued use. A bicycle pump requires a lot of pumping, but is a cheaper alternative. Use a pressure gauge (can be attached to the launch pad, air tank or bicycle pump) to keep a consistent level of pressure for each launch. An ideal pressure is 80 psi – adjust for site and wind conditions.

Rocket Derby Competition

The main goal of the rocket derby is the same as the pinewood derby – for the scout to spend quality time with his parents constructing and launching the rockets, and to have fun! Participation is much more important than the competition itself.

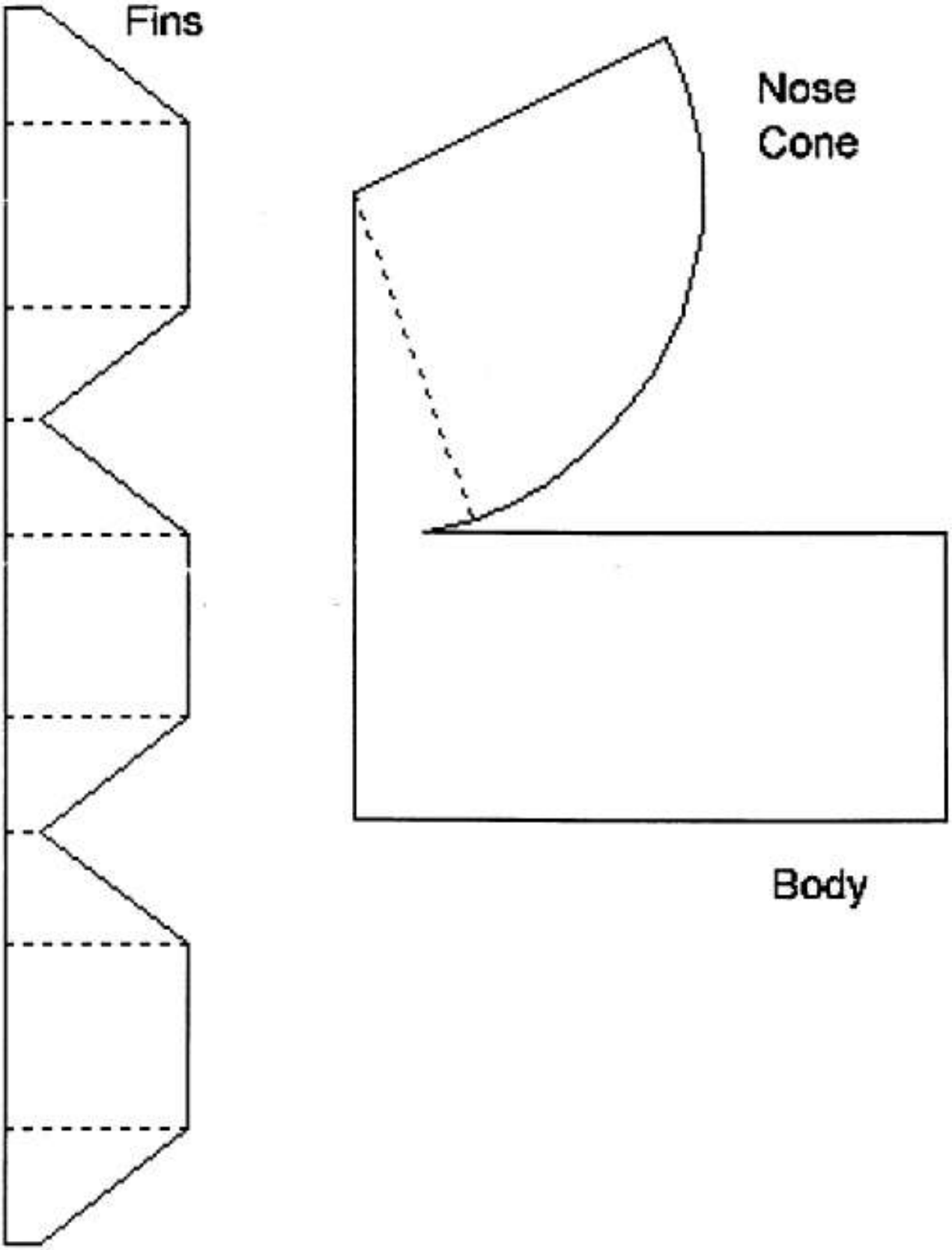
- The rocket derby can be just a fun activity to spend a nice afternoon launching rockets.
- To add the spirit of competition, ribbons or prizes can be awarded for construction (coolest looking, most unusual, tallest, shortest, most space-age), and for flight (highest, longest time aloft).

- To measure height, several height gauges can be constructed and positioned at various spots away from the launch pad. An average height should be calculated to eliminate any bias from the readings.
- To measure time aloft, time the rocket from the time it leaves the launch pad until the first part of the rocket touches the ground. If time permits, launch the rockets 2 times, and calculate the total time to determine the winner. This is the easiest method for competitions.
- Have a separate division for the siblings.

Rocket Derby Patches

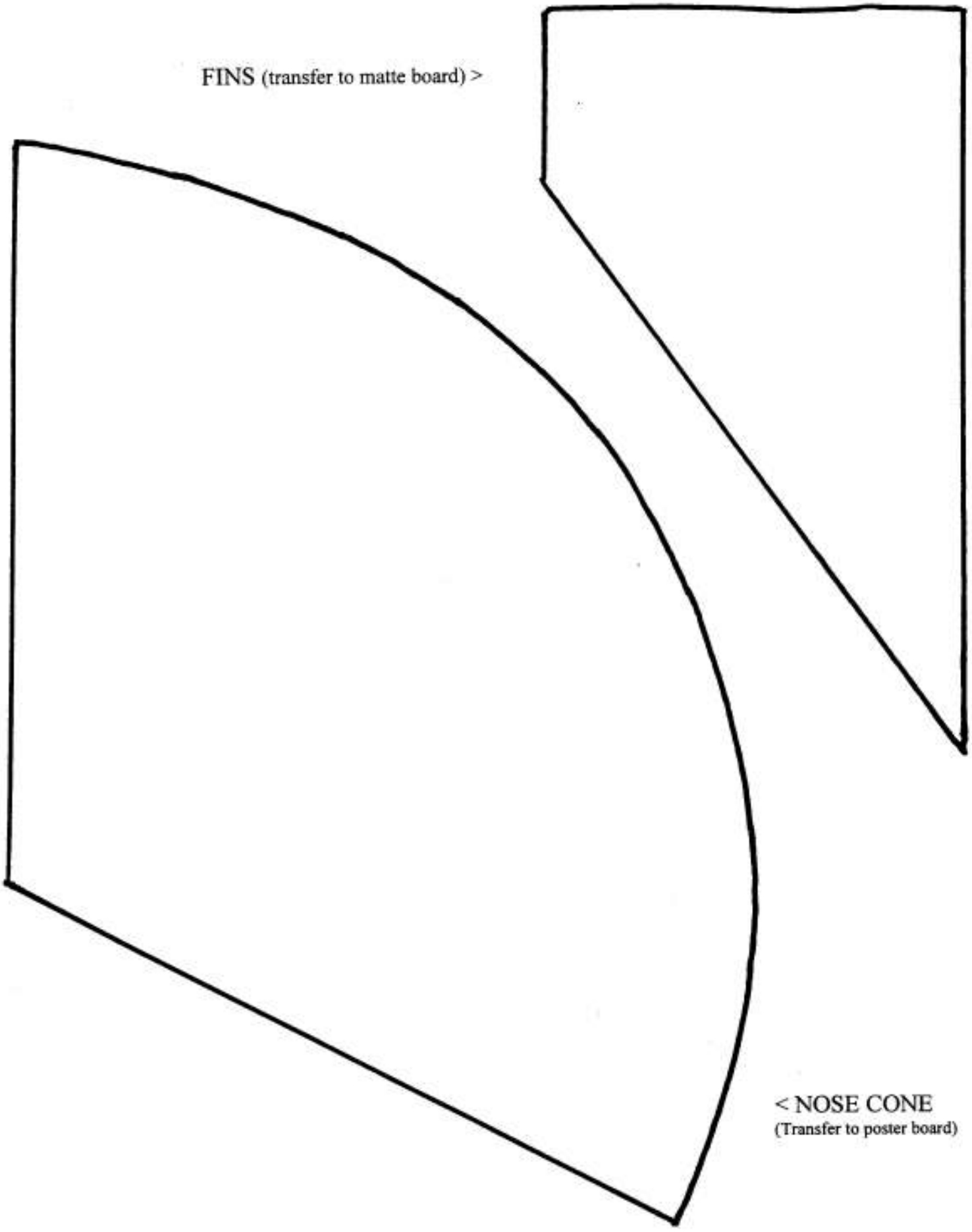
Patchsales.com has a couple of generic Rocket Derby patches available. Visit www.patchsales.com and search for "Rocket Derby." These patches are reasonably priced and can be awarded for participation in the rocket derby. The lettering on the patches may be customized for a small additional fee.

Seltzer Rocket Pattern



TUBE ROCKET PATTERNS

FINS (transfer to matte board) >



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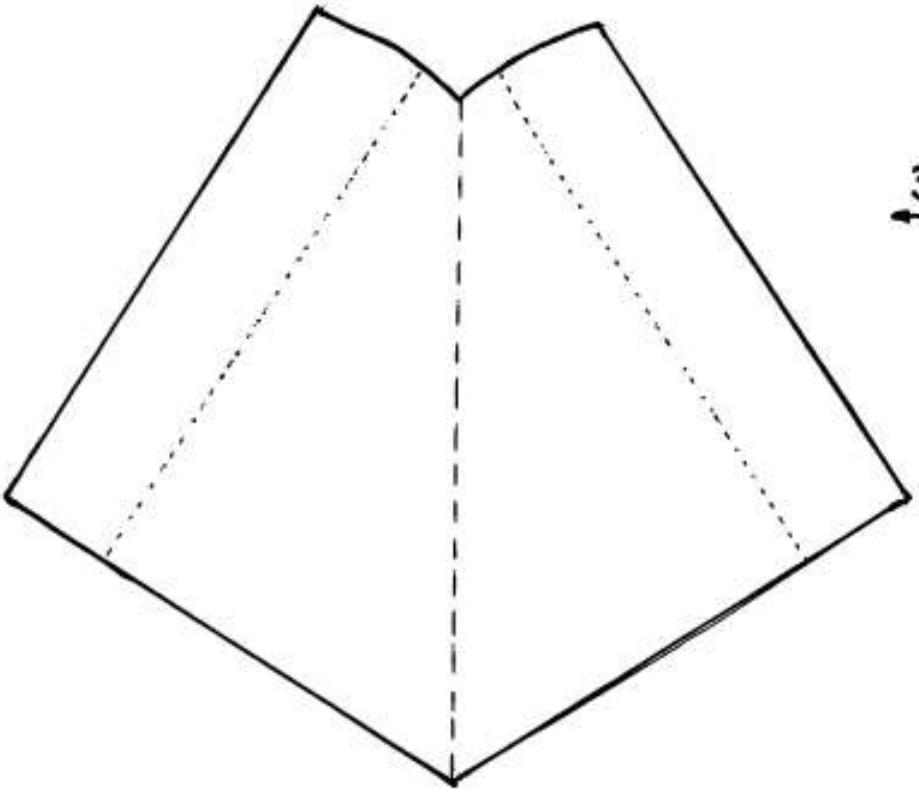
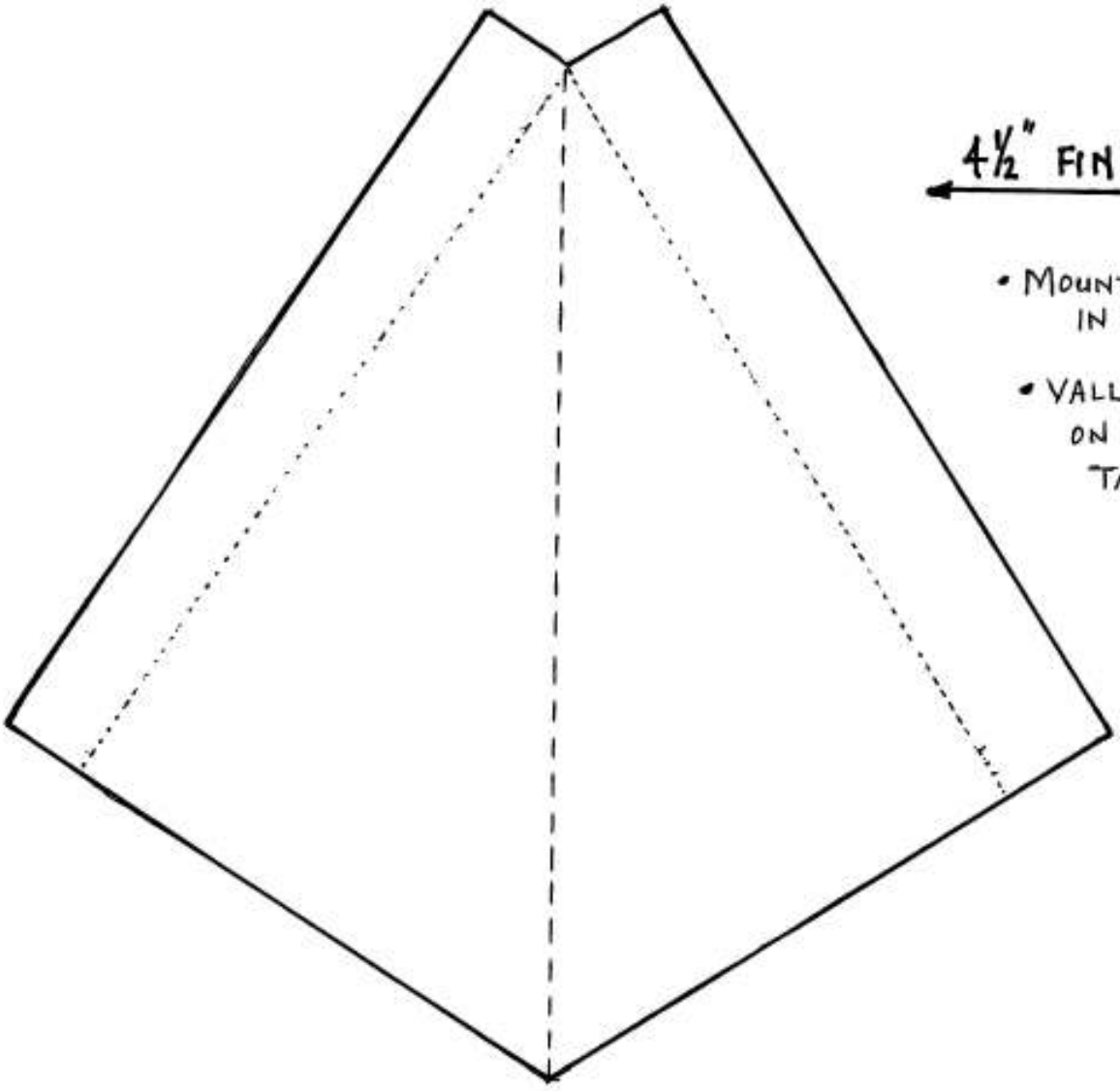
(Transfer to poster board)



3" FIN



4½" FIN

- MOUNTAIN FOLD IN CENTER.
- VALLEY FOLDS ON SIDES FOR TABS.